SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

NOTE ON THE AGE OF BASIL VALENTINE.

BASIL VALENTINE is usually reckoned as the earliest of the scientific chemists and a great light of human culture.* He is supposed to have lived nearly a hundred years before Paracelsus, or at some time in the 15th century. One of the works which bears his name certainly embodies a tolerably correct conception of the behavior of antimony. Popular writers erroneously attribute to him the discovery and the name of that metal,† together with some of the most elementary and ancient operations of the chemist. But Hermann Kopp, the least unsatisfactory of the historians of Western alchemy,‡ has emphasized certain doubts

* Thus, one historian, Schmieder, opens his chapter on Valentine with the words: "Ein Nordlicht lodert in farbigen Strahlen an Deutschlands Horizont empor."

† Even accepting the works attributed to him as authentic, it remains true that antimony had been used in type-founding before Basil Valentine's book on that metal was written. Berthelot finds the name applied to the same metal by Greek alchemists, to say nothing of its occurrence in the same sense in the encyclopedia of Vincentius Bellovacensis.

‡ Berthelot confines himself to Egyptian, Greek and Arabian authors. The work of Dr. Latz, himself a 19th century alchemist, affords some insight into the matter of alchemy. Kopp's book is of great value, although he does not pretend to have penetrated deep below the surface. Hoefer's history never had a high critical value. Schmieder and Gmelin are quite superseded. In his earlier *Beiträge* Kopp disbelieves in a real 15th Century Basil Valentine. In his *Geschichte der Alchemie* he admits the existence of such a chemist.

concerning Valentine which it is the purpose of this note to resolve.

This personage was never heard of until, in 1599, Johann Thölde published, as editor, the first of six treatises in the German language which he successively gave to the public as having been written by 'Basilius Valentinus, Benedictine monk.' The last of these, published, according to Kopp, in 1604, and entitled *Triumph-Wagen des Antimonii*, is the one upon which the renown of Valentine exclusively rests. All are works of alchemy, a doctrine that, at the time of their publication, had for generations been a mark of derision.* I have only seen four of them, the *Triumph-Wagen*, the *Welt in Kleinen*, the *Grosse Stein der uhr-alten Weisen*, and the treatise *Von natürlichen und übernatürlichen Dingen*.† The *Triumph-Wagen* is the only one I have carefully studied.

I begin with a logical consideration. It is very important to bear in mind, at the outset, that the all but universal custom of alchemists was to publish their writings as having been handed down from remote ages. This custom had been traditional since the remotest periods of Egyptian alchemy. Besides, there was an obvious reason for it. Announce to the world that a gold dollar costs you but a dime, and either you are poor, when your neighbors will laugh at you, or your circumstances are comfortable, when you will be besieged by importunities as well as exposed to the resentment of those who dread your overturning the existing *status* of property. So it would be even in our well-governed age; how much more in wilder states of society! For this reason, although for books in general the *prima facie* presumption that they were written by the persons whom they name as their authors is even stronger than critics are apt to think, yet for alchemical books this initial presumption is reversed. If a book of alchemy professes to be written by an adept, that is, by one who can make gold, there is a probability amounting almost to certainty that its real authorship is concealed, and if it professes to be written long before its publication the presumption, founded on the general practice of such writers, is that the real author is he who has given it to the world. That is the theory which logic demands should first be tried.

Now these books of Valentine state repeatedly that the author has achieved the 'great work' of the alchemists. Hence, until facts drive us from the position, we ought to begin by presuming that 'Basilius Valentinus' was the *nom de plume* of Thölde. Nevertheless, in order to satisfy those who may not assent to this view, I shall begin by showing that it is impossible to believe the averments of the books themselves in regard to their authorship.

First of all, a slight sketch of the contents of the four treatises above named may be interesting. The tract '*Von der Welt in Kleinen*,' or, as it is entitled in the edition I use, '*De Microcosmo, oder von der kleinen Welt des menschlichen Leibes*,' fills but 15 small octavo pages. The author opens with an attempted explanation of the creation of the universe, or Macrocosm, and of man, or the Microcosm. The matter out of which the world was formed was nothing. The

* Thus, Gulielmus Gratarolus (an Italian physician, inclined to Lutherism, b. 1516, d. 1568), who in 1561 published a collection of alchemical writings in two volumes folio, concludes an introductory dialogue on the subject with these words: 'Sapientiæ autem præmia divitias esse * * * nemo unquam sanæ mentis fatebitur * * * Necessarium est, ut priusquam capere incipiant, extremum infortunium, et ipsa Ἀτη, illo miserando casu fœdoque interritu dejiciat atque pessundet.'

† I only know these in the edition of 1740, which professes (for these treatises) to follow the text of Thölde, except that it corrects obvious misprints and adds some plates to those illustrating the *Grosse Stein*. I have seen these same figures attached to a different text attributed to Valentine and bearing the date 1625.

matter and form in the first stage of creation, which he calls 'die Form oder *Materia*,' was earth and water. Creation consisted in separating these two; it was a work of chemical analysis. The principal result is the earth, and the essence of the earth is *salt*. The salt of man is his body. As the second step of creation, mobility was requisite. The warm air breathed by the Creator upon the earth rendered the latter pregnant, and *sulphur* was brought forth, which is an intangible, conscious spirit, imparting, through its inflammability, warmth and motion. The sulphur of man is his soul. All animals and plants have souls. Next, the earth became again pregnant, this time of its moisture; and *mercury* was brought forth, being an invisible and intangible shape identical with the power of imagination from which results all cognition. In the microcosm, owing to its volatility, this mercury resides chiefly in the upper parts. It is the invisible spirit of the human body, plainly identical with the archæus of Paracelsus. These three things, salt, sulphur and mercury, or body, soul and archæus, are the three constituents of Macrocosm and of Microcosm alike —the *tria principia*. These three constituents must exist in all animals, vegetables and minerals. A man, for example, feeds upon beef, which nourishes body, soul and archæus. The nutrition takes place by putrefaction in the stomach. Now putrefaction is nothing but chemical decomposition. This decomposition being effected, assimilation in due proportions takes place. Thus, nourishment for body, soul and archæus must exist in the beef; that is, the salt, the mercury and the sulphur must all be contained in it. The ox, in its turn, feeds upon vegetables; and by the same argument the *tria principia* must all be present in these vegetables. Finally, the plants derive their nutriment from minerals; and thus by necessity all three constituents must be contained in the minerals. The remainder of the *brochure* seems intended to apply the doctrine of the universal presence of the *tria principia* to the tracing out of a chemical physiology of the action of various foods and medicines upon the human body. All this is diffused through a vehicle of bombastic verbiage. Curious little theories abound, such as that 'the liver must have air, else it could not laugh;' that 'the salt-spirit has its chief seat in the bladder;' 'like must be expelled by like;' 'the seven metals are fundamentally but one substance,' all of which are Paracelsian doctrines.

Following this tract, I find, in the edition I use, a sort of mountebank's speech concerning two universal medicines, called Phalaia and Asa, the former to be administered inwardly, the latter for external application. Then come some score of odes on such poetic themes as copper, vitriol, sal amoniac, tartar, etc.

In the treatise *Von dem grossen Stein der uhr-alten Weisen* we trace the same principles. The following sentence is a fair specimen of the book at its clearest: "Nimm ein Stück des allerbesten feinen Goldes, und zerlege dasselbige durch die Mittel, so die Natur dem kunst-liebenden Menschen nachgelassen, von einander, wie ein Artzt des Menschen Cörper zerlegt, und dadurch den innerlichen Leib des Menschen erfahren will, und mache aus denen Gold zurück, was es zuvor gewesen ist, so wirstu finden den Saamen, den Anfang, das Mittel und das Ende, woraus unser Gold und sein Weib gemacht worden, nemlich aus einem durchdringenden *subtilen Spiritu*, auch einer reinen zarten und unbefleckten Seele, und einem *Astral*ischen Saltze und Balsam, welches nach ihrer Vereinigung anders nicht ist, den *Mercurial*ischer *Liquor*, dasselbige Wasser ward zu seinem eigenen Gott *Mercurio* in der Schule geführet, der *examin*irte das Wasser, und da ers recht und ohne falsch befand, da machte

er Freundschaft zu ihm, und nahm das Wasser zu der Ehe, und ward aus ihnen beyden ein unverbrennlich Oel, denn der *Mercurius* ward also stoltz, dass er sich selbst nicht mehr kannte, er warf seine Adlers-Flügel von sich hinweg, und verschlang selbsten den glatten Schwantz des Drachen, und bote dem *Marti* an zu kämpffen, da fordert *Mars* seine Ritterschaft zusammen, und verschuf, dass man *Mercurium* muste gefangen nehmen, und ward ihm *Vulcanus* zu einem Stockmeister verordnet, also lange biss er vom weiblichen Geschlechte wiederum erlöset würde." I cannot help fancying that I am able to detect here a certain lack of scientific precision and perspicuity. There are books which undertake to explain how to translate that sort of lingo, telling us, for example, "aqua quandoque vocatur lapis spiritus quintæ essentiæ, quandoque vocatur terra, quandoque lapis." Probably by the aid of such a key the chemical processes of this treatise could be conjectured. I have not undertaken the task, being assured, by similar experiences, that I should only find vague hints of nonsensical coctions. Upon a long frothy disquisition follow twelve chapters entitled Keys. Each of them is furnished with an emblematic picture.

The treatise *Von den natürlichen und übernatürlichen Dingen* is written in a somewhat plainer style. After repeating the doctrine of the *tria principia*, it enters upon discussions concerning biblical miracles, the doctrine of signatures, spirits, sirens, succubæ, etc. Chapter the second treats of the first 'Tinctur-Wurzel' of the metals, which, we are told, 'is a supernatural, flying, fiery spirit, which keeps itself in the air, and naturally seeks its habitation in the ground and in water.' The remaining seven chapters treat in cryptical style of the methods of dissolving the seven metals.

The *Triumph-Wagen des Antimonii* contains, embedded in vast masses of speechifying, about thirty plainly described chemical preparations. Of these, seventeen are genuine descriptions of experiments by a skillful chemist, and are distinguished from the few perspicuous chemical directions that are to be found in Raymund Lully, in Arnold de Villanova and other medieval alchemists by the far higher grade of chemical knowledge which they evince. The remaining experiments seem to me to be conjectures never put to the test. Without such an element of fancy the theory of a medieval origin for the book would be almost absolutely negatived; from its presence nothing at all can be inferred.

The German of all four works seems to me later than Luther's Bible. Upon this matter I must speak with diffidence, however; but I leave it to the reader to compare the specimen above given with any page of Paracelsus and say which is the more modern. I cannot see how there can be room for two opinions.

The author is, in the text of each treatise named, as 'Frater Basilius Valentinus, Benedictiner Ordens.' The first three works contain little concerning his personality or age. Yet the author's preface to the *Grosse Stein* tells us that, 'da mir menschlichen Furcht zu Handen stiess,' he was led to religious reflections. He joined the Benedictines, and *after he had been a monk for a good while* (nun eine Zeitlange) he determined to devote his leisure hours 'die Natur von einander zu legen,' and to considering what earthly natures he should find the highest. He diligently studied many books which he found in the monastery, written by wise masters who had investigated the natures. Subsequently, in the desire to cure a sick brother, he took up the distillation of herbs, and this investigation occupied him for six years. At the end of that time he began to extend his chemical studies, and gradually went on from one thing to another.

Finally, he came across a mineral (doubtless antimony) by the study of which he was led to make a medicine which restored that sick brother to perfect health, so that he lived for a *long time* thereafter (dann er lebte noch lange hernach). It was still later in Basil's life that he became acquainted with the matters in the treatise on the *Grosse Stein*. If the 'Zeitlange' after he became a monk and before he began to study was *one year*; if the diligent study of many books on the natures occupied *two years*; if after his *six years'* work in distillation he performed a hundred operations in mineral chemistry, each of which in his style of procedure would take about two months on an average, so that he was occupied in this way *eight years*; if the long life after restoration to health of that brother who had been ill for at least fifteen years occupied *ten years*, and if the interval between the writing of the *Grosse Stein* and the more advanced and certainly later *Triumph-Wagen* was *three years*, we have a total of 30 years between his entering the Benedictine order and his writing the *Triumph-Wagen*. At this time he was living in the monastery. When, therefore, in the *Triumph-Wagen* he speaks of having early in life made a voyage to England, that must have been thirty years or more previously. We shall see presently the bearing of this calculation.

The *Triumph-Wagen* contains more than one indication from which to infer the age of the author. It also, by the way, informs us that he lived 'oberhalb Rheins,' that is, in the Upper Rheingau, or, say, somewhere south of and not very far from Mainz. The author in the *Triumph-Wagen*, no less than three times, speaks of the desirability of economizing parchment. Now, it would have been an unusual extravagance for a man in the 15th century to write chemical treatises on parchment. Certainly, if economy were any object, paper was easily procured. And, indeed, in Chapter III. of his earlier treatise On Natural and Supernatural Things, he himself affords the quite superfluous testimony that in his time paper mills abounded. He is always and everywhere recommending 'grobe Papier' for filters. Either, then, the talk about the necessity of abridging his book in order to economize parchment was inserted in order to impart a medieval trait, or else the *Triumph-Wagen* cannot possibly have been written later than 1460 or 1470.

Just as this indication of a date occurs thrice, so there is another which is dragged in by the head and shoulders no less than seven times in the book. It is a reference to a certain disease as having recently appeared which at the time of Thölde's publication was generally supposed to have made its first appearance in 1493. Were these seven references inserted in order to create a belief in the priority of the book to Paracelsus, or was the book really written when that disease was something new?

The name which Basil Valentine gives to this disease is very suspicious. In Germany in the 15th century it was commonly called 'die wilde Wertzen;'* but it had various other designations. Valentine, however, uses none of these. Here are his expressions:

"Die neue unbekannte Krankheit so in jetzigen Krieg-Zügen in diese Lande eingeführet worden durch die Gallier."

"Die neue Franzosen-Krankheit."

"Die Franzosen."

"Die Franzosen-Sucht."

"Die neue Krankheit des Kriegs-Leute in diesen Zeit."

"Die neue Kriegs-Sucht."

"Die Krankheit der Gallier neulich auf uns geerbet."

It is doubtful whether the malady was brought to Germany from France or from Naples. Trithemius, a contemporary Ger-

* *Proksch*, Geschichte des venerischen Krankheiten, 1895.

man abbot, says it came both ways.* It was much later, during the 16th century, that the theory of a French origin became generally accepted as certain.

But passing by this difficulty, and continuing to accept the seven passages as *bona fides*, to what date do they point? Johannes Salicetus, whose work on this pestilence was printed in 1501, says that it had prevailed in Germany since 1457.† The records of a monastery at Mainz (near which Valentine must have lived) show that a chorister there was attacked by it in 1472,‡ so that it was already spreading beyond the army; and so famous a physician as Basil Valentine boasts of being would certainly have heard of that case. But Valentine says it was brought to Germany, not by German soldiers coming home, but by French soldiers in the 'present war.' I do not know what war that could have been, unless it was the struggle of Charles the Bold, not far from the Rheingau, which lasted from 1464 to 1477. Thus, if the book is genuine at all, we find again that it must have been written about 1470.

There is a third indication of the date. Namely, the author tells us that in his youth he learned in England the process of making beer with hops, which process he describes. He adds that in Germany this method is not very common, thus implying that it was very common in England thirty years or more before he wrote the *Triumph-Wagen*, or, say, about 1430 or 1440. Unfortunately, all authorities agree that hop-brewed beer was not introduced into England till very long after. I find the date 1551 given as that of the first planting a hop-garden in England. Men could not have had much experience of hop-brewed beer as long as hops were considered to be an adulteration. Now, under Henry VIII. penalties were imposed against that mode of brewing. Basil, however, speaks of it as a great improvement, and never hints at any condemnation of it. This is a difficulty that it seems impossible to avoid.

There are others. The author was a far more accomplished chemist than any other of the 15th century or of the early part of the 16th. How can it be that such a man lived a long life and never imparted any of his skill to any scholar?

Moreover, he accomplished, he tells us, cures which astounded physicians. Being a very superior man otherwise, he must have become famous. Yet Kopp, with all his learning in alchemy, declares that there is nowhere any mention of him before 1599. I know of but three statements which could be brought against Kopp's generalization, and all three break down under examination. In the first place there is a story traced to the *Sapientia Insaniens* of the Dutch alchemist, Jacob Tolle, a book which I understand to be a commentary upon the *Triumph-Wagen*,* that the Emperor Maximilian I., in 1515, undertook to collect facts concerning the life of Basil Valentine, and that, unable to obtain any information, he finally sent to Rome and caused search to be made of the rolls of the Benedictine order, which search was unsuccessful. But this story is incredible. The busy Maximilian interested himself in everything except chemistry. In 1515 he was absorbed with Hungarian affairs. But these are the least of the objections to the tale. To suppose Basil Valentine was heard of in 1515 is almost to suppose he was living about 1470. In that case there must have been numerous persons near Mainz, who per-

* Ibid.
† Ibid.
‡ Ibid.

*If I have seen an entire passage of a book, or have otherwise conclusive evidence of its containing certain matter, I consider myself justified in saying so, even if I have not seen the whole book. In the present case, however, the story may be told somewhat differently by Tollius.

sonally remembered so great a healer. Besides, how should his name have been missing from the Benedictine rolls? The facts must in some way have been mistaken by Tolle. Give me leave, then, to offer a conjectural emendation of the story. Let me suppose that, instead of Maximilian, it was the Emperor Matthias who made the investigation, or possibly even Rudolph II. The latter was a devoted alchemist; the former was at least in the way of hearing a good deal about alchemy. If it was Matthias, the date might be changed from 1515 to 1615, when the Emperor, having just concluded a long truce with the Turks, was enjoying unwonted leisure. If it was Rudolph, the search must have taken place not later than 1612. In either case the the recent publication by Thölde would naturally have suggested the inquiry, and the fact that the name was not found is explained in the simplest manner by supposing there had never been such a man as Basil Valentine.

In the second place, Count Guden, in his History of Erfurt, is quoted as saying that Basil Valentine lived in 1413 in St. Peter's monastery in that town. But manifestly that could not have been the author of the *Triumph-Wagen*, with his *Franzosen-Sucht*. Besides, Kopp assures us that the roll of that monastery bears no such name.

In the third place, Sprengel, writing in Ersch und Gruber, cites a passage of Guanerius referring to Basil Valentine. I doubt if the citation has ever been verified. At any rate, since Guanerius died, in 1440, our author cannot have been intended by him.

Finally, as another difficulty, the question arises where could Basil Valentine have acquired his ideas, wild as they were, and his skill in chemistry? Paracelsus, the son of an eminent physician, running all over Europe in his thirst for knowledge, and undoubtedly a great man, might very well have gained such ideas directly or indirectly from Arabian sources. But Basil Valentine, though by no means hiding his knowledge under a bushel, nowhere boasts, as far as I know, of any acquaintance with Arabic.

Thus, the attempt to sustain the hypothesis of a real Basil Valentine creates a new difficulty with every new circumstance and feature of the facts that we learn. Let us turn, then, to that hypothesis which ought logically to have been adopted at first, namely, that Thölde was himself the author, and see whether the facts may not fit into that better. Those which we have already had occasion to notice certainly do so.

But let us ask who was Johann Thölde? He was a man of means, part proprietor of a chemical industry, the salt works at Franckenhausen, and the secretary for many years of the Rosicrucian Brotherhood, a society founded on literary fraud and saturated with it.

And how does this secretary of a society of humbug account for his possession of the MSS? Does his tale bear the marks of truth? The story is well known. The brotherhood pretended that their founder had been buried at the ripe age of 106 in the house of the Holy Spirit at Erfurt, having directed that his epitaph should read 'Post CXX annos patebo.' Accordingly, that time having elapsed, one of the pillars of the chapter-house burst and disclosed ancient books embodying the doctrines of the brotherhood. We have a list of some of those books, but the only ones of any consequence are the treatises of Basil Valentine. If you believe the story of the bursting pillar, you will believe these books authentic. If not, you will believe them to be the forgeries of Thölde and his brethren, who really stole the ideas of Paracelsus and in one only of the books inserted some solid chemistry.

When we once come to regard the *Triumph-Wagen*, no longer as antedating Copernicus,

but as a production of the age of Galileo, Harvey, Gilbert and Keppler, it does not appear as a marvelous performance. The only circumstance at which one hesitates is that a scientific chemist, whose mind moved in the world of reality and veracity, should have mixed the description of his experiments with so much degraded bombast. We can only surmise that the wealthy Thölde, or the master spirit behind him, purchased these secrets of antimony from some indigent chemist and worked them into the otherwise nonsensical book in which they appear.

C. S. Pierce.

STUDIES FROM THE ZOOLOGICAL LABORATORY, HARVARD UNIVERSITY.

The following abstracts of papers prepared in the Zoological Laboratory of the Museum of Comparative Zoology at Harvard College have been made by the authors. The final papers will be published as soon as the plates necessary for their illustration can be prepared. Other papers, not readily given in abstract, or requiring illustrations to make them intelligible in that form, will be published soon.

E. L. Mark.

Ovogenesis in Distaplia occidentalis Ritter (MS.), *with Remarks on other Forms.* (Abstract.) By F. W. Bancroft.

The material was all obtained on the coast of California. In the compound ascidian *Distaplia*, only, was it attempted to make the investigation at all complete. Here the development of the sexual organs, though in several respects simpler, conforms to the type described by Van Beneden et Julin in 1885. Both ovary and testis are derived from a common fundament, which, on account of the differentiated oögonia it contains, is recognizable in even the smallest buds of the older colonies.

One of the diagnostic characters of the genus *Distaplia* is the capacious brood pouch in which the embryos are kept. It is attached to the zoöid by a narrow stalk and has usually been described as a diverticulum of the peribranchial sac. The embryos are arranged so that the youngest are at the tip of the organ. It was found to be not a simple diverticulum; the stalk of the pouch is double, consisting of two narrow tubes, one of which is a continuation of the oviduct, while the other opens into the peribranchial sac. The oviducal tube opens into the bottom of the pouch, and it is on account of this arrangement that the younger embryos are always found in the tip of the organ. In passing from the ovary to the pouch the ovum is greatly compressed, assuming the shape of a sausage, but becomes oval as soon as it has entered the pouch.

The test cells are seen to be derived from the follicular epithelium, and not, as Davidoff has maintained for this genus, from within the ovum. The cytoplasm of the test cells has been stained from the earliest stages on, and strands of cytoplasm are seen during all the earlier stages connecting the test cell with the follicle in somewhat the same way that Morgan has described. However, at this period, bends in the wall of the germinative vesicle and accompanying vacuoles in the cytoplasm are occasionally encountered, and it is likely that these appearances are what has been described by Davidoff as nuclear evaginations from which the test cells are formed. They are probably due to shrinkage. There are also deeply staining granules in the cytoplasm, which often have vacuoles around them, and then look exactly like Davidoff's figures of nuclear buds that have already become detached from the germinative vesicle. But they do not produce the test cells, as this author thinks. The test cells are found to take no part in the formation of the test of the embryo, as has recently been maintained by Salensky. The outermost

follicular epithelium, which remains behind in the ovary when the ovum passes into the pouch, forms a very conspicuous corpus luteum, which persists for a considerable period.

In the colonies studied, both the youngest buds and the the adult zoöids contained about the same number of oögonia, so that in these the whole of the ovogenesis consists in growth and maturation only. The yolk bodies, which are very large, begin to be formed at the periphery of the ovum when it has reached about half its final diameter. At this time the germinative vesicle has reached its maximum size; it has a full outline, a conspicuous stained network and a large nucleolus. From now on, while most of the yolk is formed and the ovum acquires the last seven-eighths of its ultimate volume, the germinative vesicle decreases in size, until it has but half its maximum diameter, acquires a stellate outline and a marked avidity for most stains. The shrinking of the germinative vesicle, then, is not associated with maturation in this case, but with yolk formation.

The nucleolus, though usually obscured by most stains, persists with little change throughout this shrinking. It does not form the stellate body found in the old ova, as Davidoff maintained, but is found within this body, which is itself the remains of the germinative vesicle. The nucleolus at this stage is quite complex, consisting of a homogeneous cortex, an eccentric finely granular medulla, and within the latter several very highly refractive bodies, the largest of which may have a granular appearance. During the greater part of the growing period these refractive bodies are the only substance in the germinative vesicle that takes the chromatin stain with a methyl green and acid fuchsin combination. However, shortly before the egg leaves the ovary chromatin is detected in other regions of the vesicle, so that it is probable that the tetrads are not formed from any part of the nucleolus. These refractive bodies persist even after the ovum has passed into the oviduct and the rest of the nucleolus, together with the germinative membrane, can no longer be seen.

The tetrads, of which there appear to be normally twelve, are formed during the passage of the egg through the oviduct. Two polar cells are formed, but in neither of the divisions accompanying their production nor in any of the earlier cleavages has any centrosome, aster or spindle fibre been found, although several good preparations of these stages have been obtained. In all of these processes the amount of granular undifferentiated cytoplasm is very small; by far the greater part of the ovum is filled with yolk bodies, between which no interstitial cytoplasm can be detected. It may be that the absence of these characteristic accompaniments of mitosis is due to the small amount of active cytoplasm present.

Observations on Non-Sexual Reproduction in Dero vaga. (Abstract.) By T. W. GALLOWAY.

BUDDING may take place in any of the setigerous segments from the 16th to the 21st.

Number of segment.....	16	17	18	19	20	21
Percentage of occurrence...	7.6	15.3	38.2	26.7	7.6	4.6

In the anterior zoöid subsequent bud-zones are produced in the same segment in which the first occurred. When the posterior individual reproduces, the bud-zone may be in the segment bearing the same number as that of the anterior zoöid, or it may be in front or posterior to that segment. It is thus the posterior zoöid which introduces the variability. In Dero the relation between the normal increase of segments and budding is such as to suggest

that the latter is a specialized form of the former.

The place of separation is interseptal; the anterior half-segment produces an anal segment and a preanal, undifferentiated, segment-forming zone; the posterior half forms four cephalic segments and the prostomium.

The ectoderm by ingrowths between the longitudinal muscle bands produces in the posterior zoöid the brain, the circumœsophageal connective, the sub-œsophageal ganglia, four pairs of ventral bristle-sacs and two latero-ventral invaginations, the walls of which contribute to the formation of the buccal wall. The floor and roof of the mouth are also ectodermal, but are formed, upon the separation of the zoöids, by the free mid-dorsal and mid-ventral margins of the body wall, which are drawn into contact with the entoderm by muscular action. In the anterior zoöid the ectodermic ingrowths fuse with one another and with mesodermal elements to form an undifferentiated zone, from which new segments are added to this zoöid. The nerve cord, the dorsal and ventral bristle sacs, and the peripheral portions of the nephridial organs, are contributed by the ectoderm.

The entoderm increases in thickness throughout the bud-zone by the multiplication of sub-epithelial cells. In two regions this becomes pronounced. In the posterior zoöid a thick wall of long, columnar, ciliate epithelial cells is produced, surrounding the old tube. This outer wall soon becomes separated from the old wall by a distinct space, the lumen of the new pharynx. Anteriorly this new pharyngeal wall becomes continuous with the ectodermal portion of the wall of the mouth; posteriorly it extends to the dissepiment bounding the bud-zone. The wall of the old gut continues functional until the individuals separate, and is then detached and swallowed. In the anterior zoöid there is a thickening of entoderm immediately in front of the future plane of division. This arises in a way wholly similar to the pharyngeal wall, and, like it, becomes separated from the wall of the gut. It is cilitated and is destined to become the wall of the pavilion, which probably subserves a respiratory function. From the mesoderm arise new muscular fibres, blood vessels and dissepiments.

Effect of Temperature on Growth of Tadpoles. (Abstract.) By T. W. Galloway.

Tadpoles of Rana, Amblystoma and Bufo were reared, without other food than was contained in the eggs, under different temperature conditions (varying from + 16° to + 25°C.), to an age of 30 to 70 days. Through a comparison of the total weight, the dry weight, the amount of water and the ratio of the dry weight to the total weight, the following conclusions were reached: (1) Increase of temperature, within the above limits, accelerates cleavage and the rate of imbibition of water (especially the latter), but does not appear to produce any definite change, either of increase or decrease, of formed substance; (2) organisms reared in the warmer conditions tend to attain a slightly higher maximum percentage of water than those subjected to lower temperatures; and (3) individuals reared for sometime in a low temperature showed, after transfer to a higher temperature, a greater rate of imbibition of water than those kept from the beginning in the warmer chamber.

Structure and Development of the Antennal Glands in Homarus americanus. (Abstract.) By F. C. Waite.

The adult organ consists of three portions, an endsac, labyrinth and vesicle. The endsac lies spread over the dorsal face of the labyrinth, and closely applied to it. These two portions of the gland are in communication at one point only, which is in

the anterior region of the organ. The labyrinth is continuous at its anterior median lobe with a short duct which leads to the exterior and opens on a tubercle on the base of the antenna. The large vesicle lies dorsal to the endsac and opens into the duct leading from the labyrinth, but has no direct communication with either the endsac or labyrinth. The histological structure of the labyrinth and endsac are different and the transition at the point of communication between their cavities is sharp. The histological structure of the vesicle is very much like that of the labyrinth.

The first appearance of the organ in the development of the embryo is at the time when the first and second pair of antennæ, the mandibles and the first maxillæ are marked off. This is approximately 15 to 18 days after egg extrusion in summer (August) eggs. The organ at first consists of a differentiation of certain mesodermic cells in the axis of the second antenna near its proximal end. These form the endsac. The lumen is intracellular. About ten days after the first differentiation of the cells which are destined to form the endsac, and at a time when this part of the organ is well marked, there appears an ectodermic ingrowth from the ventral face of the second antenna. It is at first solid, but within a short time an intercellular lumen is formed. From this ectodermic ingrowth arise the labyrinth, the duct to the exterior, and the vesicle. Thus the two parts arise independently, one from the mesoderm, the other from the ectoderm, and each has characteristic histological conditions throughout development. They are both well marked and with distinct lumina at about six weeks (for summer eggs) after egg extrusion, but not until a comparatively late period of embryonic development (about one month before hatching) do the lumina of these two parts become confluent. At the time of hatching each part is a relatively simple sac, but during larval life a complexity approaching that in the adult organ is reached. This is brought about by a series of evaginations of the walls of the sacs, which later anastomose in a variety of ways, and not by the coiling of a tubule. The histological conditions seem to indicate that the organ is not functional until the beginning of larval life.

The results obtained as to the development are in general accord with the conditions found by Kingsley in Crangon and by Boutchinsky in Gebia, but are at variance with the development of the organ in Astacus as described by Reichenbach.

RAISED SHORE-LINES ON CAPE MAYSI, CUBA.

AT the eastern end of the island of Cuba, on and in the vicinity of the promontory known as Cape Maysi, is the most magnificent example of raised shore-lines as seen from the ocean that I know of. They are in the form of huge wave-cut benches extending with perfect regularity and practical horizontality along the face of a long moderate slope and around several promontories. When a profile of the latter is seen from a passing ship the sharp-cut, step-like form readily attracts the attention even of the unscientific observer. The terraces are found one above another at somewhat irregular intervals, are of different degrees of development, possibly as much as a dozen in number, and seem to extend to an altitude of about 1,000 feet above the sea. Above the last terrace visible the land has a topography indicative of sub-aërial erosion. The view is backed by the high range of the Copper Mountains, whose crest along this portion of the island is smooth and even compared with most West Indian mountain ranges.

To the geologist the terraces of Cape Maysi are chiefly interesting because they demonstrate a recent uplift of this part of the island of Cuba. This is singular, be-

cause the island of Jamaica, but little more than 100 miles distant, is without evidence of such a very recent uplift. To a certain extent the two islands have had a different geologic history.

The extreme recency, geologically speaking, of the uplift of Cape Maysi is indicated by the perfection of the terraces. They have suffered practically no sub-aërial erosion. Although the land is a comparatively steep slope, constituting a very favorable situation for erosion, no gutters, ravines or valleys were seen from the ocean, with two exceptions. Even these exceptions tell of the newness of the land surface. They are two deep narrow cañons formed by streams flowing down over the terraced slope. Where exposed on the precipitous face of one of the large raised sea-cliffs, the cañons are just as narrow at the top as at the bottom.

I am inclined to believe that the beginning of this series of unsteady or periodic uplifts of the eastern end of Cuba belongs later in the geological scale than the opening of the Modern or present period, and it is continuing at the present day. The sea is now engaged in forming a sea-cliff and narrow submarine shelf precisely like the raised shore-lines above it. In not a very long time, perhaps a few hundred years, another incipient uplift will be due and another and lower bench begun.

These few remarks have been given to stimulate the study of this eastern Cuban region, which will result in some important additions to our knowledge of West Indian geology. Undoubtedly other travelers have noticed these beautiful terraces on Cape Maysi and studied them from passing ships, as I have, but a landing should be effected on the coast and a close examination of them made, particularly of the two dark cañons above mentioned.

Oscar H. Hershey.

June 24, 1898.

CURRENT NOTES ON ANTHROPOLOGY.

ARCHIVE OF THE SCIENCE OF RELIGION.

The second number of this journal confirms the favorable opinion created by its first issue.

Professor Siecke, of Berlin, begins a profound study of the god Rudra in the Rig Veda (the Vedic prototype of Siva), and one by Dr. Waser on the Greek Charon. Professor Steinthal discusses the associations of the toad in mythology, while the editor, Dr. H. Achelis, considers the theory of the origin of religion from social psychology. Several reviews close the number, one a note upon 'kyanthropy,' or the transformation of the human into the dog form. This is allied to the better known 'lycanthropy,' but is familiar even in American folk-lore, where the 'black dog' is still regarded as the uncanny embodiment of the Evil One. The article reviewed is by Roscher in the *Transactions* of the Saxon Society of Sciences. The *Archiv* is published by J. C. B. Mohr, Leipzig.

ARCHÆOLOGY OF CORSICA.

A report by M. Caziot in the *Bulletin* of the Paris Anthropological Society (1897, Fasc. 5) contains new information on the archæology of Corsica.

Neither the caverns nor the fields yield traces of palæolithic man; but numbers of axes in polished stone, points of arrows and lances, scrapers and hammers show that in neolithic times the island was inhabited.

Pure native copper occurs in the mountains, and was exploited during the neolithic epoch. The quarries are still found, and many objects in pure copper must be referred to the late stone age. To this time, also, are attributed the dolmens and ancient graves where inhumation was practiced. Pottery in that epoch was scarce and rarely made.

Following the close of the polished stone age, those of bronze and of iron are dis-

tinctly marked, represented in history by the successive conquests of the Etruscans, Romans and Merovingians. Megalithic monuments and remains of ancient walled cities attest the conflicts of these possessors of the land.

THE RACES OF EUROPE.

DR. J. DENIKER, a high authority, gives in *L'Anthropologie* for April the results of his long and minute studies on the constitutive races of Europe outside of those who we know were historical immigrants (Semites, Finns, Lapp, Huns, Gypsies). He makes six 'primary' races as follows: (1) Blond, dolichocephalic, tall, in the north; (2) blond, sub-brachycephalic, short, in the east (Great Russia, eastern Prussia); (3) dark, short, dolichocephalic (Iberians); (4) dark, short, brachycephalic (Celts, Rhætians); (5) dark, tall, mesocephalic (littoral of Mediterranean); (6) dark, tall, brachycephalic (about the Adriatic).

To these he would add several 'secondary' races, with the somatic criteria more or less mixed.

He does not claim that these are original types. They are all the result of admixtures of several lines; but the distinct prevalence over wide areas of the characteristics named justify the assumption of lineage.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

ATTENTION was recently called to the determination of the atomic weights of cobalt and nickel by T. W. Richards, of Harvard, in conjunction with Cushman and Baxter. The method used was the determination of the bromin of the bromids by weighing as silver bromid in a Gooch crucible. In the last *Zeitschrift für anorganische Chemie*, Clemens Winkler, of Freiberg, criticises their work in three respects: presence of the oxybromid; possible presence of hydrobromic acid not removed by heating in nitrogen; use of Gooch crucible. He considers the method used by himself in his work a few years ago much less liable to inaccuracy. In this the electrolytically deposited metal was acted on by excess of iodin in presence of water, and the iodin not used measured by titration with standard sodium thiosulfate solution. Winkler's results are $Ni = 58.86$ and $Co = 59.51$ as against Cushman's $Ni = 58.69$ and Baxter's $Co = 58.99$ $(O = 16)$. It is noticeable, however, that while these results differ among themselves, in both cases the atomic weight of nickel appears to be less than that of cobalt, while the periodic law would seem to require the reverse to be the case.

IN the same number of the *Zeitschrift*, Alfonso Cossa, of Turin, announces the discovery of tellurium in the concretions on the inner wall of the crater of Vulcano (Lipari Islands). These concretions are largely of potassium aluminate; thallium, cesium and rubidium also being present. In the same region large quantities of potassium fluosilicate are found. The amount of tellurium recovered was about 2 gm. per 3 kilos material. Selenium is present in the stalactites of sulfur, but in far smaller quantities than tellurium.

PROFESSOR LEBEAU has been experimenting on the action of the heat of the electric furnace on the emerald in a carbon tube. The experiments were carried out in some cases on as much as 100 kilos of emerald. With a current, 950 ampères, 45 volts, most of the silicia distils off and there is left a melted mass with metallic luster. This is a mixture of carbids of aluminum and of glucinum, and silicids of iron and of carbon. Dilute acids dissolve the mass, giving solutions of aluminum and glucinum. If hydrofluoric acid is used, fluorid of glucinum is

obtained, fluorid of aluminum being insoluble.

In another number of the *Comptes Rendus*, M. Lebeau describes fully the fluorid of glucinum. It is exceedingly soluble in water and even alcohol, and is deliquescent. It fuses at a fairly high temperature in an inert atmosphere, but heated in the air it forms an oxyfluorid $5GlF_2, 2GlO$, also soluble in water.

According to Wm. A. Bone and John Wilson, in the latest *Proceedings* of the Chemical Society (London), acetylene when exposed in closed glass tubes to the sunlight is gradually decomposed. In June a faint brownish deposit is observable at the end of two or three days. No deposit is found on any part of the tube not exposed to the sunlight. The nature of the black deposit has not yet been fully determined, but it seems to be a very dense hydrocarbon; no benzene nor naphthalene could be found. This decomposition is what might be expected from the endothermic character of acetylene, and it may possibly come to play a part in the industrial manufacture.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE CHICAGO ACADEMY OF SCIENCES.

We have received the 14th annual report of the Chicago Academy of Sciences, covering the year 1897. From the report of the Secretary and Curator, Mr. F. C. Baker, it appears that the number of visitors to the Museum during the year was over 245,000, including the formal visitation of 133 classes from the Chicago schools, attended by their teachers. Thirteen popular lectures were given, with an average attendance of 300. The accessories to the Museum numbered 15,457, twenty-eight collections having been presented. The President of the Academy, Professor T. C. Chamberlin, in his report states that the survey of the natural phenomena of Chicago and its environment, which has been in progress since 1892 under the auspices of the Academy, has made progress during the year. Its work has been so connected, by an informal understanding, with that of the United States Geological Survey as to avoid needless duplication and to render the work of each serviceable to the other. As the fruit of this and by the generous assent of the Director of the United States Geological Survey, a bulletin on the Pleistocene formations of the Chicago area and of the outlying territory, prepared by Mr. Frank Leverett, of the National Survey, has been published by the Academy, and has already proved itself helpful to citizens of Chicago and especially to students of the geology and geography. An elaborate and amply illustrated bulletin on the mollusks of the Chicago area by Mr. Baker is now in press. Three additional manuscript reports are essentially completed, and it is anticipated that bulletins on well-borings, on birds and on the Phenogamous and Cryptogamous Plants of the region will be issued during the coming year. The National Survey has during the year completed the field work upon four of its standard atlas sheets, embracing the greater part of Chicago and its environment, based upon contour maps previously prepared. While these are wholly the work of the United States Geological Survey, and will be published by it, they contribute effectively to the ends sought by the Survey of the Academy, in the presentation to the people of Chicago and to the schools, of ample and trustworthy data relative to the natural phenomena of the city and its environment.

GENERAL.

Professor Rudolf Virchow has been made an Associate of the Paris Academy of Sciences. He was for many years a corresponding member.

Professor Roberts-Austen has been elected president of the British Iron and Steel Institute.

Mr. Herbert Bolton, who for the last eight years has held the post of assistant keeper in the geological department of the Manchester Museum, has been appointed to the curatorship of the Bristol Museum. The Manchester Museum advertises for a successor to Mr. Bolton. It offers a salary of $400 a year!

DR. KRIECHBAUMER has been made a curator of the State zoological collections at Munich.

SIR GEORGE STOKES gave the presidential address before the Victoria Institute, London, on July 18th, his subject being 'The Perception of Color.'

THE ROYAL SOCIETY has appointed a committee which it is expected will cooperate with a committee appointed by the British Colonial Office in investigating the causes of malaria, more especially the relation of the mosquito to the malarial parasite. It is expected that grants of money will be made by the Royal Society and the Colonial Office for the purpose of sending a commission to India and Africa.

THE directors of the Ben Nevis Observatories announce that the high- and the low-level observatories at Ben Nevis will cease to exist in October owing to want of funds. The directors state that by the establishment of these observatories a great experiment has been carried out with signal success. A series of hourly observations has been obtained by night and by day without a break over a period of 15 years.

THE Berlin Academy of Sciences held on June 30th a public meeting to celebrate the birthday of Leibnitz. Professor Waldeyer, who presided, spoke on the scientific work of the Academy, and the newly elected members, Professor Engelmann and Kekulé von Stradonitz, made inaugural addresses.

PLANS are being made for the foundation of a French *Association des Anatomistes* to include those interested not only in human and comparative anatomy, but also students of histology, embryology and anthropology. The Association will meet annually in some university center, Paris having been chosen for the place of the first meeting, to be held next year.

THE Archæological and Historical Society of Belgium held its annual meeting at Enghien from the 7th to the 10th of the present month.

THE sulphate of ammonia committee, concerning the functions of which we are not informed, advertises a prize of 500 guineas for the best essay on the utility of sulphate of ammonia in agriculture; the essays must be received not later than November 15th, by W. G. Blagden, Esq., 4 Fenchurch Ave., London, E. C.

THE *British Medical Journal* reports that a department for the treatment of hydrophobia by Pasteur's method and for scientific research on the subject of hydrophobia has just been opened in the Berlin Institute for Infectious Diseases (Koch Institute). This establishment is the first of its kind in Germany. Apparently rabies is becoming more frequent in Germany. In spite of the stringent legislation on muzzling, five persons died of hydrophobia in Prussia during the year 1897.

THE British House of Commons devoted its session of July 25th to a somewhat desultory discussion of the Vaccination bill. A clause has been inserted to the effect that no parent or other person should be liable to any penalty under Section 29 or Section 31 of the Vaccination Act of 1867, if within four months from the birth of the child he satisfied two Justices in petty sessions that he conscientiously believed that vaccination would be prejudicial to the health of the child, and within seven days thereafter delivered to the vaccination officer for the district a certificate of such conscientious objection.

Nature states that Professor Max Weber, of the University of Amsterdam, will leave Europe in October next, for Sourabaya, Java, to take command of a scientific expedition, projected by the Society for the Biological Investigation of the Netherlands Colonies, for the zoological, botanical and oceanographical exploration of the seas of the Indian Archipelago. The course of the expedition, which will last about a year, is divided into two sections. The first, starting from Sourabaya, will pass through the Timor and Tenimber groups of islands to the Aroos and Ké Islands and thence to Banda or Amboina, a total distance by the route selected of about 2,500 English miles. The second section, starting from Banda or Amboina, will pass between Halmaheira and Celebes through the chain of islands leading up to the Philippines, and return to Java by the channel between Celebes and Borneo, making a traject of some 3,000 miles.

A DISPATCH from Vancouver, B. C., says that

Dr. Terwange, who has been for some time making preparations, left for Skaguay on Friday to look for Herr Andrée and his balloon. At Skaguay he will be met by eight other members of the party and M. Varich, head of the expedition. It was intended to make the search for Andrée first in a balloon capable of carrying 9,000 pounds. It was decided to take a smaller and speedier air-vessel, however, and one which will carry 5,000 pounds was built in Vancouver, B. C. Supplies have been sent around by St. Michael's, and will be cached at different points along the river. The expedition is under the auspices of the Geographical Society of Frence.

We learn from *Natural Science* that the government of New South Wales has fitted out a deep-sea trawling expedition for experimental fishing off the coasts of the colony. Mr. E. R. Waite, of the Australian Museum, is attached as naturalist, and much valuable material, including many new species, is finding its way to the Museum.

The botanical expedition to the La Plata Mountains of southwestern Colorado, organized by Professor C. T. Baker, and accompanied by Professors S. M. Tracy and F. S. Earle, has returned after being five weeks in the field. It was originally intended to extend the work over a much longer period, but the illness of one of the members of the party prevented. The work will be continued another year, which is amply justified by this season's results. Collections of the greatest value have been made, the number of specimens taken in the five weeks exceeding twenty-five thousand. Many novelties (a new *Lupinus*, a new *Gilia* and other new things) and many rarities (as, for instance, *Ranunculus Macauleyi* in flower and fruit, *Ligusticum eastwoodiæ*, *Trifolium brandegei*, *Astragalus heydenianus*, *A. lonchocarpus*, *A. scopulorum*, *A. wingatensis*, etc.) were collected in quantity and will be issued in the sets which have been subscribed for by most of the greater herbaria of this country and Europe.

Three Italian investigators, R. Nasini, F. Anderlin and R. Salvadori, who have been engaged in the study of gases emanating from the earth, write to *Nature* that in the spectrum of the gases "of the Solfatara di Pozzuoli, which contain argon, we have found a sufficiently bright line with the wave-length 531.5, corresponding to that of corona 1474 K, attributed to coronium, an element not yet discovered, and which should be lighter than hydrogen. This line has never before been observed in earthly products. Besides we have noted the following lines: 653.5, 595.5, 536.2. In the spectrum of the gases gathered from the Fumarole of Vesuvius we have observed the lines: 769.5, 631.8, 572.5, 636.5, 441.5, and again 595.5. All these lines do not belong to the spectrum of argon or helium; they show a coincidence or proximity only with some unimportant lines of various elements, such as iron, potassium, titanium. Considering the conditions of our experiments, the presence of these elements in the gases we have studied is not probable. The line 572.5 is near to one of nitrogen, but being the only visible line of the spectrum of this gas it cannot be attributed to it. Besides coronium we have thus probably other new elements in these gases."

Dr. J. N. Rose, of the National Museum, contributes to the ninth report of the Missouri Botanical Garden a paper of several pages, illustrated by three plates, on several Agaves which have bloomed in the Botanical Garden at Washington. One of these, the original home of which is not known, is described as new, under the name *A. Washingtonensis* Baker & Rose. Some years since, Professor Williams described and figured, for the first time, fruiting specimens of the rather common lichen *Parmelia molliuscula*. In a brief note of a recent publication in the same report of the Missouri Garden, Mr. Henry Willey calls attention to the existence in his collection of another specimen in fruit.

A dispatch to the daily papers from Vienna says that Dr. Leo Lillienfeld, of that city, has demonstrated to the Chemical Congress, in session there, the discovery of a method of producing artificial albumen, identical with natural albumen, which hitherto, it has been believed, could only be produced by organic means.

We called attention recently to the prize of $10,000 offered by the Belgian government to

the inventor of a match containing no yellow phosphorus. Mr. Cunningham has called attention to the fact that if the head of an ordinary 'safety' be dipped in the paste which is put upon the sides of the match box, and which contains red phosphorus and sulphide of antimony, the match will be found capable of igniting upon any surface. Meanwhile it is said that in France the State engineers have succeeded in giving a formula for making lucifer matches which does not include either white phosphorns or any substance injurious to the health of the hands or that of the public. Machinery has also been ivented which will contribute to the health and safety of the hands. The machinery has been tested; after a few improvements have been made in it, it will be generally adopted in the government lucifer match factories.

THE Governor of Madagascar, the native government of which has recently been supplanted by that of civilized France, has issued an order forbidding any except Frenchmen to collect fossils in the island. *Natural Science*, which takes this information from the *Geographical Journal*, which finds it in the *Politique Coloniale* for May 25th, properly asks whether the naturalists of France, official and otherwise, have been consulted on this subject, or whether it is merely the order of a politician ignorant of the methods of scientific men.

DR. GEORG WALTEMATH, of Hamburg, is insatiable of moons. He has sent us, under the date of July 20th, an announcement of a third moon for the earth. This moon is said to be 427,250 kg. distant and is 746 km. in diameter. It is nearer than Dr. Waltemath's other moon, and is a 'wahrhafter Wetter-und Magnet-Mond.' Perhaps it is also the moon presiding over lunacy.

UNDER the editorship of Professor Joseph S. Ames, of Johns Hopkins University, the Harpers announce a series of scientific reprints similar in plan to Oswald's Klassiker der exacten Wissenschaften. The first volume of the series will include the papers by Guy-Lussac and Julien Thomson on the free expansion of gases, and the second, Fraunhofer's papers on prismatic and diffraction spectra.

THE Berlin correspondent of the London *Times* telegraphs that an appeal has just been made to patriots, thinkers, writers, and to the world of thought and culture in Germany at large, to unite together in the foundation of a Kaiser Wilhelm Library for Posen, similar to that subscribed for and presented to the city of Strassburg after the war of 1870–71. The library is to be presented to Posen for the purpose of furthering German culture and influence among the Slavonic population and for combating the ever-increasing antagonism of the Poles. The importance of Germanizing the Poles has been recognized as a growing necessity, and for that purpose a provincial library in Thorn and a technical high school in Danzig are to be established. The ultimate foundation of a German university in the province of Posen is considered as a future possibility. In the meantime donations and offerings of books are earnestly solicited, and by spreading German knowledge it is hoped to diffuse a strong feeling for German ideas among the peasantry of East Prussia.

UNIVERSITY AND EDUCATIONAL NEWS.

PROFESSOR SIMON NEWCOMB will next year resume the active superintendency of the work in mathematics and astronomy in Johns Hopkins University. He expects to give a course of lectures on the Encyclopædia of the Mathematical Sciences, and will especially direct students pursuing advanced work in celestial mechanics.

THE chair of physics in McGill University has been filled by the election of Mr. Ernest Rutherford, and the chair of organic chemistry by the election of Dr. J. W. Walker. Professor Rutherford comes from New Zealand, but has recently been in residence at Trinity College, Cambridge, holding the Couttes-Trotter Studentship. Professor Walker has been since 1896 lecturer in organic chemistry in University College, London.

THE assistant professorship of civil engineering in McGill University is vacant. Candidates should apply by letter to the principal, whose present address is 81 Iffley Road, Oxford.

BUILDINGS of the Niagara University, a Cath-

olic institution near Niagara Falls, have been destroyed by fire, supposed to have been of incendiary origin, involving a loss of $70,000.

Herr von Miquel, Prussian Minister of Finance, has proposed a plan for taxing professors of medicine who also practice. His plan would result in paying no salary to professors who have a practice of the value of $5,000.

Dr. Steven Crowe and Dr. E. S. Pillsbury have been elected lecturers in bacteriology in the College of Physicians and Surgeons, San Francisco.

The University of Pennsylvania has this year awarded five senior fellowships, two honorary fellowships, fifteen regular fellowships for men and five for women and the Hector Tyndale Fellowship. The awards in science are as follows: *Senior Fellowship:* Chemistry, W. L. Hardin. *Honorary Fellowships:* Botany, A. F. Schweley and S. C. Schmucker. *Fellowships:* Pedagogy, C. D. Nason; Chemistry, Alfred Tingle; Biology, J. M. Greenman; Mathematics and Astronomy, J. M. Hadley; Sociology, G. R. Wicker; Mathematics, J. B. Faught. *Fellowships for Women:* Psychology, A. J. McKeag; Chemistry, L. G. Kollock. *On the Hector Tyndale Foundation:* Physics, M. G. Lloyd.

Dr. Georg Klebs, of Basle, has been appointed professor of botany in the University at Halle. Dr. Hefs has been promoted to a full professorship of physics in the Lyceum at Bamberg. Dr. Holde has qualified as docent in chemistry in the Technical Institute at Charlottenberg, and Dr. Kopsch in anatomy in the University of Berlin.

DISCUSSION AND CORRESPONDENCE.

STABILITY IN GENERIC NOMENCLATURE.

In the June number of the *Botanical Gazette* Dr. B. L. Robinson has called attention to the fact that the Rochester Rules do not provide criteria for determining the application of generic names. It is also pointed out that a strict interpretation of the principle of priority would demand that the first species placed under a genus should serve as its nomenclatorial 'type,' to which the name should remain attached. The execution which such a rule would work among the older names is, it appears, the reason why the makers of the Rochester Code have hesitated to enact or put it in practice. This omission is criticised as gravely inconsistent in a system of 'absolute and decisive character.'

Much nomenclatorial discussion has failed of any definite purpose for lack of agreement as to the nature of the taxonomic problem. Consciously or unconsciously, systematists belong to two schools, representing, for the purposes of illustration, the idealists and realists. According to the former, systems of classification and their categories are mental concepts merely—pigeon-holes, so to speak, into which the individual units of biologic phenomena can be assorted. If the arrangement of the pigeon-holes prove too inconvenient, changes may be necessary, but these are made with reluctance, and it is fondly hoped that each readjustment may be the last. The idealistic systematist views nature from the standpoint of the system, and while he may not be a philosophic idealist as well, and deny the material existence of the objects of his study, he not infrequently declares, and uniformly acts on the opinion, that species, genera and families do not exist in nature, but are *made* by the naturalist. In accordance with this view, the various categories mentioned consist primarily of *definitions* to which names are attached. The usage of the earlier systematists corresponded somewhat to our present custom of patenting new inventions. If the definition or specification proved faulty it was set aside, name and all, and a supposedly improved combination of characters was arranged for the consideration of posterity. This was entirely just and logical, for if the genus (definition) did not correspond to anything in nature it was of no use to the naturalist and should properly give way to the clearer concept of the later student with his presumably wider knowledge of forms. No uniformity nor stability could come, however, from such a method; biologic progress would mean an endless succession of names, an infinite mass of competing generic concepts to be sifted and arranged, constituting an almost insurmountable barrier between nature and formal knowledge. To avoid this threatened chaos it became customary to retain older names, emend the descriptions and credit

the genus to the emendator. Confusion also attended this practice in that it soon became difficult to ascertain the character and importance of the changes worked by successive students, and opinions greatly differed as to the merits of the various references, so that on the ground of convenience merely there has been an increasing tendency to credit the genus to its original author, the inventor of the name, and ignore the fact of subsequent emendation. This is, then, a practical abandonment, for nomenclatorial reasons, of the custom of treating the genus as a mental concept, and the purport of the original description has come to be so far ignored that the Rochester Code bases botanical nomenclature on a work which contained no definitions of genera, necessitating that all knowledge of them be gained by inference from the included species.

But the above view as to the nature of genera is as false in theory as it has proved impossible in practice. Species, genus, family and order are as actual and real as regiment, division and corps or other collective nouns. It may not be possible to define the terms to the satisfaction of all, but for nomenclatorial purposes it is quite sufficient to know that a species is a group of individuals, and a genus a group of species. If we think of a species as an island in the sea of extinction a genus is an archipelago, a group of neighboring islands. There being no biological latitude and longitude, we are obliged to indicate the islands and the group by describing them. The history of geographical discovery has proved that it is not easy to distinguish by description between numerous similar islands, and systematic science has in the last decades abandoned the description as the final resort for the interpretation of the species and taken to the original specimen or 'type.' It is still protested by the surviving idealists that no single specimen can give an adequate idea of the species, and nobody claims that it can, but the desirability of a single definite nexus between nature and science is rapidly becoming patent to all. A complete description of a species can only be drawn after it is known throughout its range and variations, and until its entire life-history has been ascertained, but the preservation of a type specimen renders easy and definite the settlement of questions which could in many cases never be positively decided otherwise. The discoverers of an island may reach it from different sides, and may disagree in the accounts of what they saw, but if their points of observation are known later travelers can harmonize the discrepancies, correct the errors and complete the description.

The method of types is rapidly becoming universal in the study of species, but with respect to genera the idealists are still much more in evidence. The case is, however, exactly the same. A genus being a group of species, it is more satisfactory and final to know one of the species than to hear any amount of general remarks about the group as a whole, especially if the region has not been thoroughly explored and mapped. The discoverer of a new genus simply recognizes that a certain species, or more, lies at a distance from any of the groups which have been previously designated as genera. In a majority of cases he becomes aware of this fact through observation on some single species, which he proceeds to describe and figure with special care. He may not know the size, direction or extent of his new archipelago; all the general characters he alleges as features of the group may fail in the light of later study, and yet the fact would remain that he had first recognized as distinct from all others that particular group of species. As before, the genus cannot be truly defined, the characters by which it is distinguishable cannot be formulated, till all the species are known. The characters might, indeed, long elude us without impairing the distinctness of the genus. The species and genus, in the realistic view, are in an important sense independent of characters, the formal characters being the means of pointing out the group, rather than the primary ground of its existence. The description, whether by ancient or modern writer, loses its sanctity and is distinctly subsidiary in authority to the type.

The idealistic theory having proved impracticable, the method of types is being rapidly substituted, even without the recognition of a logical base for its use. An objection is sometimes raised that as the early systematists did

not work under this method it cannot be justly applied to their groups. This criticism is, however, entirely misplaced, for strict justice would result in setting aside nearly all their genera, as they served those of their predecessors, for scarcely any were adequately defined. The modern custom is not only just, but generous, since it proposes to incorporate and give permanent recognition to groups which under their authors' theories would be in continued jeopardy.

The method of definition and the method of types tend, indeed, to converge in practice and might ultimately coincide as knowledge became perfect. The point of view, however, has a very important bearing on the question of stability of generic names during the constant process of change which increasing insight into nature must work in any system of classification. If a genus is a definition its application will continue a matter of individual preference and doubt, but if a genus is a group of species it will, in accordance with the law of priority, bear the oldest name first used to designate any of its members. The method of types as applied to genera rests, accordingly, on a more important consideration than its convenience as a rule of nomenclature, and the use of the first species as the type of the genus in cases where the author did not himself designate a type has a more important sanction than attaches to it as an extreme development of the principle of priority, for it, or some similar rule, is necessary to any *system* which undertakes to produce stability in the application of generic names. The only alternative method yet suggested is that of elimination; it is an invention of the idealistic school, is ambiguous and difficult of application, and is directly inimical to stability, since one readjustment in generic names may necessitate numerous others, even in distinct families. The method of types renders the application of generic names absolutely stable, and by this very stability provides the flexibility so necessary in allowing classification to keep pace with increasing knowledge. To secure these ends seems quite as important as much of the existing legislation, but several American botanists of prominence to whom these reasons have been presented at length, while admitting the correctness of the contention, hesitate, like Dr. Robinson, to advise the sweeping changes which would be required.

The second element which, if not overlooked, has not been formally reckoned with in plans for nomenclatorial uniformity is human nature. Some have believed that almost any system or treaty of agreement once adopted by a majority would soon become universal.

Drs. Kuntze and Robinson deny this with emphasis. The former says: "The rules of nomenclature should neither be arbitrary nor imposed by authority. They must be founded on considerations clear and forcible enough for every one to comprehend and be disposed to accept." (Codex Emendatus, Art. 2.) And Dr. Robinson makes two separate declarations to the same effect: "Surely those who have themselves discarded hundreds of names which had stood unchallenged for nearly a century should not feel that they are establishing their system merely by putting it into use. The only way it can be established is by making it so reasonable and consistent that it will command general respect and approbation." (P. 438.) "But no system which is not in itself logical is likely to stand the test of time." (P. 440.)

These strike the keynote of the whole question of systems. There are those, and not a few, who will yield adherence to no system which does not appear to them coherent, complete, catholic. The system, if anything, must be everything; considerations of convenience have little weight with these true systematists. Any exception, deviation or ambiguity is a blot which disfigures the whole fair page and must be removed at any cost of time or pains. It is of no use to say that all nomenclature is for convenience merely; that it is a means, not an end; that its purpose is to save, not increase, labor. Then, too, it is idle to leave out of account the personal and moral elements. The satiated describer of hundreds of species may profess that the question of justice is not pertinent, but justice is, and doubtless will remain, at least equally important with logic. If we do not realize this ourselves we need only observe the enthusiastic amateur who leaves the luxuries of wealth and position to ransack the

world for a new bird, orchid or butterfly. Will he respect a system which legislates away from others an honor he so greatly covets for himself?

There is, perhaps, no sufficient *reason* why we may not make any number of exceptions, set chronologic limits, or otherwise minimize the changes which would attend the thorough application of the principle of priority, under the method of types, but if ultimate uniformity is our aim it will probably prove unwise to include any such modifying principles or rules; unwise, not for botanical, but for human considerations, because there are and will be those to whom the reasons for our exceptions will not appear sufficient; whose regard for the system will demand its emancipation from all artificial trammels, none the less because these are a legacy from a past which recognized carelessly, or not at all, the principles now considered fundamental. A fifty-year concession, for instance, is one of the specious suggestions of the Continental botanists. This apparently simple arrangement would duplicate the difficulties which Dr. Robinson finds in applying the Rochester Rules. Who would decide what constitutes 'use'? Would mention as a synonyn in a compiled work like the 'Index Kewensis' be sufficient to save a name from oblivion? What about the numerous genera of fungi, for instance, which have not been rediscovered in the last half century and may not be found again in the next? That the Editor of the Synoptic Flora takes ground against the Rochester Rules because of their incompleteness furnishes weighty evidence that there are but two practical nomenclatorial alternatives, a definite, complete and invariable system elaborated, as far as possible, on the line of a single principle, or a return to the chaos of unguided individual preference. Dr. Robinson must be either an extreme radical or an ultra-conservative, or be open to exactly the same criticism which he visits upon the Rochester Rules. If these Rules lack any of the attributes of a successful system they must be supplied under pain of ultimate oblivion, but those who do not follow the Rules must either go farther, as Prof. Greene and others have recently done, or they must not claim consideration as apostles of uniformity, at least until they have proposed a system which they are ready to adopt.

The practical incompatibility of usage and uniformity is well illustrated by Dr. Robinson on page 438, where, starting with a recognition of the 'great value of priority,' it is soon found that principles 'should be based upon usage and derive their guiding power by stating, generalizing and correlating usage, and not by defying it.' It may be questioned whether this second system sketched by Dr. Robinson is really a system at all in any practical sense, since it would, as there indicated, leave nomenclature in the same condition as grammar, where between conflicting rules individual taste is the only arbiter. As a system all the complicated parts of such a code would be open to criticism and invite disagreement. Usage has never produced any general or permanent uniformity in manners, government, literature or science, and no reasons are apparent for supposing that it ever will. There could scarcely be a uniform logical system founded upon usage. The idea involves a contradiction of terms, and a plea for usage is, in effect, a plea for anarchy.

To some the Rochester Code recommended itself not so much as a perfect system, but rather as a ground of compromise in the interest of uniformity in nomenclature. As with all compromises, neither the radicals nor conservatives are satisfied, and criticism is possible from both standpoints. The existence of a considerable amount of literature based on the nomenclature of the Rochester Code does not improve the character of that document as a system, but it tends to lessen the force formerly carried by the argument from usage. The event shows already that the chief obstacle to uniformity is not, after all, usage, for that can be changed, but that it lies rather in the elements of human nature noticed above, whereby the earnest systematist is impelled to insist upon considerations of justice and logic which to him appear axiomatic and promise universality. It is becoming certain that systematic workers demand a *system*, and Dr. Robinson emphasizes the demand that the system shall be not only logical and consistent, but that it be complete and definite to the extent that if honestly followed it will produce the uniformity which is at

once its purpose and test. In accordance with this view, it might prove simpler, as well as more honest and logical, to make any desired concessions to usage as exceptions rather than by introducing subsidiary rules of doubtful sanction, such as the fifty-year limit. We could then work with the ideal before us, and such differences as continued to exist would concern particulars merely.

Many of the points treated in the various codes are, relatively, matters of slight importance, and are doubtlesss capable of being settled for all except the most cantankerous by simple rules or by-laws which might accompany a general platform or code, since in many such matters usage furnishes the only criterion of judgment and no logical or moral principles are involved. Instead of being essentially complicated, however, nomenclature is in reality a very simple matter. Stability and uniformity are the prime requisites, and these can be attained under the binominal system by adhering to the use of the oldest specific name without regard to generic reference, and by confining the application of a generic name to the genus in which its assigned type or first binominal species is included. The complicated and debatable nature of the various codes arises from the neglect of these principles or from attempts at limiting their application, either for avoiding bibliographic labor or in the interests of usage.

O. F. Cook.

U. S. National Museum,
July 27, 1898.

SCIENTIFIC LITERATURE.

SOME RECENT WORKS ON MECHANICS.

A Treatise on Analytical Statics. By E. J. Routh. Cambridge, University Press. 8vo., Vol. I., pp. xii + 407, 1891; Vol. II., pp. xii + 224, 1892.

Traité de mécanique rationelle. Par Paul Appell. Paris, Gauthier-Villars et Fils. 8vo., Vol. I., pp. vi + 549, 1893; Vol. II., pp. vi + 538, 1896.

The Elementary Principles of Mechanics. By A. Jay Du Bois. New York, John Wiley & Sons. 8vo., Vol. I., pp. x + 231, 1894; Vol. II., pp. viii + 392, 1894; Vol. III., pp. x + 296, 1895.

Dynamics. By P. G. Tait. London, Adam and Charles Black. 1895. 12mo. Pp. xii + 361.

Elements of Mechanics. By Thomas Wallace Wright. New York, D. Van Nostrand & Co. 1896. 12mo. Pp. viii + 392.

Applied Mechanics. By John Perry. New York, D. Van Nostrand & Co. 1898. 12mo. Pp. viii + 678.

Ueber die Theorie des Kreisels. Heft I., Die Kinematischen und Kinetischen Grundlagen der Theorie. Von F. Klein und A. Sommerfeld. Leipzig, B. G. Teubner. 8vo. Pp. iv + 196.

The didactic excellence of the numerous treatises on the principles of mechanics which have appeared in recent years demonstrates an increasing appreciation of the importance of those principles and a progressive effort towards brevity and lucidity in their exposition. The doctrine of energy, now about half a century old, has not only supplied new ways of visualising the familiar and of investigating the unfamiliar in mechanics, but it has also forced us to recognize the omnipresence of mechanical phenomena. The growth of this doctrine and the accompanying developments of the mathematico-physical sciences have furnished, during the past twenty years especially, extensive additions in subject-matter and in applications not hitherto available to writers of works on mechanics. Almost equally important with these additions in the way of material are the improvements in terminology which have been slowly but surely gaining general approval during the present half century. The new points of view afforded by the doctrine of energy, and the critical spirit which has given precision to the terminology, have led also to a revision of the foundations of mechanics. Recent writers devote much space to explanation, illustration and discussion of the so-called axioms of the science; and the trend of current thought is toward the conclusion that most of these axioms are not such at all in the Euclidean sense, but that they are facts of nature which have been discovered by observation. Less stress than formerly is now laid on alleged mathematical proofs of mechanical principles and more attention is given to the phenomena wherein

those principles apply. The old notion that mechanics is merely a branch of applied mathematics is giving way to the more philosophical view that the core of the science consists in its physical principles and that mathematical analysis plays the secondary though wonderfully important rôle of the most effective instrument for investigating mechanical phenomena.

Students who are acquainted with Routh's Rigid Dynamics will easily anticipate the character of his Analytical Statics; and students not familiar with either should hasten to pursue both works, for in many respects they are the best treatises extant. Their excellence consists in clear exposition of principles, in detailed application of those principles to typical examples, and in elaborate collections of instructive problems.

Volume I. of the work on statics consists of eleven chapters having the following titles: The Parallelogram of Forces; Forces Acting at a Point; Parallel Forces; Forces in Two Dimensions; On Friction; The Principle of Work; Forces in Three Dimensions; Graphical Statics; Centre of Gravity; On Strings; and The Machines. Amongst these the chapter on the principle of work is of most practical importance. That on strings, subject to any forces and including the elastic catenary, is also replete with useful as well as instructive information.

Volume II. consists of three parts, devoted to attractions, including the theory of the potential function; to the bending of rods; and to astatics, respectively. While each of these is a capital contribution, the first is by far the most interesting and important. Though not exhaustive, it is probably the most readable and instructive exposition of the theory of attractions and potential function in the English language. The part devoted to the conditions of equilibrium of bent rods is somewhat novel in a treatise on statics. It would seem rather to belong in a work on the theory of elasticity. Without going into the complex details of the latter, however, the author has considered many of the most important properties of bent and twisted rods, including the case presented by helical springs. The last part presents, in about forty pages, an excellent summary of the principal theorems which have been discovered in the interesting though not specially useful subject of astatics since its foundation by Moebius in his Lehrbuch der Statik in 1837.

For more than one hundred and fifty years the French have held first rank in the production of treatises on mechanics, and their reputation is well sustained in the admirable work of Appell. In his two rather bulky octavo volumes he has given a very comprehensive view of the whole science of rational mechanics. The mode of treatment is distinctly French. One is continually reminded of the clearness and elegance of the great masters, Lagrange, Laplace, Poisson and Poinsot. The salient feature of the work is perfection of mathematical method, the point of view of the author being apparantly that of the mathematician rather than that of the mechanician.

Volume I. consists of three parts. The first of these is devoted to the theory of vectors, kinematics and the elementary theory of kinetics. The second is devoted to statics and gives a very complete treatment of the subject in all its essential aspects, much space being allotted to the method of virtual displacements. The third part treats of the dynamics of a point and includes a luminous exposition of the principles of d'Alembert, Lagrange and Hamilton.

Volume II. consists of two parts. The first of these treats of the higher methods of Hamilton and Jacobi in application to the dynamics of a point, and the second is devoted to the dynamics of systems in general. The author's exposition of the principles of d'Alembert; of the energy method of Lagrange; of the principle of least action; and of all the elaborate mathematical machinery of Poisson, Hamilton and Jacobi, seems to be more complete and satisfactory than that afforded by any other single work. Every important principle or process is illustrated by application to one or more typical examples, and many unsolved problems are appended to the main chapters of the work. The text bears evidence of careful proof reading, since the number of misprints is very small for a work of so many pages.

The defects of this treatise, though unimportant to all but the novice, are characteristic of

Continental writers on mechanics. They consist in the use of antiquated if not ambiguous terminology, like 'vitesse virtuelle,' 'quantité de mouvement,' 'force vive,' etc.; and in the treatment of mass as a mere mathematical inconvenience to be got out of sight, if not out of mind, as soon as possible.

As may be inferred from the three volumes aggregating upwards of 900 pages, there is room in the work of Professor Du Bois for pretty thorough treatment of the elements of mechanics. A detailed examination of the work will convince one that this room has been well filled. Many parts of the work might have been much condensed and some parts might have been omitted entirely without detriment to an elementary book, but it was the purpose of the author to prepare a text-book which would be of use to students during the whole of their college course and afterwards as a work of reference. This purpose, it must be said, has been very well executed, and the work will prove exceedingly useful to teachers and professienal readers as well as to students.

The plan of the work is in accordance with the divisions of the science adopted by Thomson and Tait in the Natural Philosophy; the first part being devoted to kinematics, and the last two to dynamics, that is, to statics and kinetics respectively. The development of the fundamental principles is systematic and logical, and an invaluable feature of the volumes is found in the large number of numerical examples fully worked out. By means of typographical devices the author appeals to all classes of readers, the paragraphs in large type forming an abridged course, the articles in small type being for advanced students, and articles involving the use of the calculus being set off by brackets. Italics and full-face type are also used with a freedom which seems Teutonic rather than English in its tendencies, and many readers will wonder how statements which are already admirably clear and intelligible are rendered more so by those pictorial devices.

The volumes devoted to kinematics and statics are very full of well arranged and digested matter for an elementary work, the volume on statics containing also four chapters (158 pp.) on retaining walls, elasticity of materials, theory of flexure and the continuous girder, respectively. The volume on kinetics is likewise quite complete, all but one short chapter on the gravitational potential being occupied with what may be called pure theory.

Amongst many commendable features of the work of Professor DuBois special mention should be made of the clearness of definition and the precision of terminology which prevail throughout the volumes. In these respects the work is on the whole especially satisfactory. The only exceptions we have noted are in Chapter VIII. of Vol. III., wherein the potential as defined by equation (1) does not appear to have the dimensions assigned to it in problem (11). In the same chapter also, p. 113, a well known theorem of Gauss is attributed to Laplace; while on pp. 114 and 115 Poisson's extension of Laplace's theorem is referred to without explanation of Laplace's theorem itself.

Professional and unprofessional students who have read Professor Tait's profound article on mechanics in the last edition of the Encyclopædia Britannica welcome the reprint of that article with additions in the handy text-book form presented by the Messrs. Black. Some modifications of the original article have been made in this reprint, and the subjects of attractions, hydrostatics, hydrokinetics and waves have been incorporated as additions. The result is a treatise on dynamics which for thought-promoting information per unit area is equalled only by the Natural Philosophy of Thomson and Tait. Every student will feel a regret that the author did not enlarge the work much beyond its present limits. This regret is especially keen with respect to Chapter V., wherein the methods of Lagrange and Hamilton are all too briefly developed. But the author anticipated and answered this criticism. In his preface he says: "One obvious objection may be made to many parts of this book—undue brevity. It was inevitable, when much had to be compressed into moderate space; yet, at the worst, is not brevity, if it but convey its message, transcendentally preferable to prolixity?"

The work of Professor Wright is a completely rewritten edition of his book on mechanics published a few years ago. A larger page and

larger type have been used, and the work is in every respect an improvement over the earlier edition. The scope of the book is limited to coplanar kinematics and dynamics, and it seems remarkable that so much of the groundwork of the science is covered in spite of that restriction. The author has also limited himself in the use of the calculus, the book being so arranged as to form a consecutive elementary course without resort to that branch of mathematics which is still a mystery to many well developed minds. On the other hand, by such limited use of the calculus he seeks to prevent the student 'from thinking, as is often the case, that there is a kind of mechanics called elementary, another analytical, a third theoretical, and so on.' For the average student, it must be admitted, this type of book is more readable than any other, and we can heartily recommend Professor Wright's book as one of the freshest, most interesting and most instructive of the type. In the old days, when all students of some colleges were compelled to pursue mechanics, it was commonly considered a 'dismal science.' Saxe, in his Reflective Retrospect, says:

"I recollect those harsh affairs,
The morning bells that gave us panics.
I recollect the formal prayers
That seemed like lessons in mechanics."

But no one can read Professor Wright's book without being interested at least in the historical references and apt quotations he has worked in along with the formal parts of the science. Even the ponderous gravity of John Milton has to submit to a sly dig from the wily mechanician. Witness this conclusion from Milton's data:

"Men called him Mulciber: and how he fell
From heaven they fabled, thrown by angry Jove
Sheer o'er the crystal battlement: from morn
To noon he fell, from noon to dewey eve,
A summer's day: and with the setting sun
Dropt from the zenith like a falling star,
On Lemnos th' Ægean isle."

"Taking the summer's day fifteen hours, show that the distance of Lemnos isle from heaven is about one-fourth of the distance to the moon."

Of a radically different type from any other work noticed in our list is the text-book on applied mechanics of Professor Perry. It is also quite different from the standard works on the subject by Rankine, Weisbach and others. In fact, it is a unique work, full of information as an egg is full of meat, and written in a style which is very lively in comparison with the sedate models set by previous writers. As stated on the title-page, the book is intended to be 'A treatise for the use of students who have time to work experimental, numerical and graphical exercises illustrating the subject.' As to the qualifications of a reader taking up the work the author says in his preface: "I should like to think that, before a student begins the part in small type, he has worked through Thomson and Tait's small book on Natural Philosophy, and that he has read the early part of my book on 'The Calculus for Engineers.'" The vigorous way in which the views of the author are set forth may be inferred from the following quotations from the introductory chapter:

"When we think of what goes on under the name of teaching we can almost forgive a man who uses a method of his own, however unscientific it may seem to be. Nevertheless, it is not easy to forgive men who, because they have found a study interesting themselves, make their students waste a term upon it, when only a few exercises are wanted—on what is sometimes called the scientific study of arithmetic, for example, or of mensuration."

"In our own subject of Applied Mechanics there are teachers who spend most of the time on graphical statics, or the graphing of functions on squared paper, or the cursory examination of thousands of models of mechanical contrivances. One teacher seems to think that applied mechanics is simply the study of kinematics and mechanisms; another, that it is the simple exercise work on pure mechanics; another, that it is the breaking of specimens on a large testing machine; another, that it is trying to do in a school or college what can only be done in real engineering works; another, that it is mere graphics; another, that it is all calculus and no graphics; another, that it is all shading and coloring and the production of pretty pictures without center lines or dimensions. Probably the greatest mistake is that of

wasting time in a school in giving information that one cannot help picking up in one's ordinary practical work after leaving school."

"In teaching beginners it is well to start on the assumption that students already possess the notions of the differential and integral calculus, and it is the teacher's duty to put before them the symbols used in the calculus at once. It is surely much better to do this than to evade the calculus in the fifty usual methods which we sometimes see adopted."

The book contains thirty chapters, followed by an appendix of useful tables, including 4-place logarithms and anti-logarithms, and a full index. Every chapter is replete with useful information, and most topics are treated in ways that are refreshing by reason of the novelty of method and the incisive language of the author. We may not in all cases accept his views or approve his style, but there is not a dull page in the text, and his views and style are everywhere entertaining and instructive. There is much new matter in the book, and the numerous illustrations (371 of them) are in general excellent, many of them exhibiting apparatus designed by the author and now published apparently for the first time. To teachers, to engineers and to readers of mechanics, as well as to students, this book cannot be too highly commended.

During the hundred years ending with the first half of the present century the most important contributions to mechanical science were made by writers who were alike eminent as mathematicians and and mechanicians. Such were the great masters Lagrange, Laplace, Poisson, Cauchy, Gauss, Dirichlet, Lamé, etc. Since that time, however, the mathematicians and mechanicians have parted company to a great extent and their diverging paths have presented little in common. Whether this fact is to be regretted or not must be left for the historians of our times to decide. In the meantime each according to his bias will rejoice that pure mathematics is not, or that pure mechanics is, deeply concerned with things material. Those subject to the latter bias will rejoice that the prestige of the Göttingen school of mathematicians is maintained by the presence of Professor Klein in the field of mechanics.

The volume before us is an elaboration, through the aid of Dr. Sommerfeld, of Professor Klein's lectures at the University of Göttingen. It does not pretend to be a systematic treatise, but, very appropriately, assuming a general knowledge of mechanics on the part of the reader, proceeds to discuss, in considerable detail, the typical problem of the top in its kinematical, kinetic and mathematical aspects.

The book is divided into three chapters. The first of these is occupied with the kinematical principles of the problem, and the systems of coordinates required to specify the motion of a top are elaborately considered. The most important novelty of the work in this part consists in the very natural introduction of complex numbers and quaternions, about one-fifth of the chapter being devoted to the latter.

The second chapter considers the principles of kinetics and develops the formulas applicable to the notion of a free mass and to the rotation of a rigid body, special emphasis being given to the theory of impulses. The last chapter is devoted to Euler's equations of rotation and to their integration; and a promise is indicated that the following volumes may treat, among other applications, the important problem of variations of terrestrial latitudes. Both of these chapters present much that is novel with respect to matter and mode of presentation, leading us to await with interest the appearance of subsequent volumes.

In one respect the authors are, we think, open to a criticism which will apply also to many other Continental writers on mechanics. Since the appearance of Thomson and Tait's Natural Philosophy and Maxwell's Matter and Motion, progress in the ideas as distinguished from the methods of mechanics is attributable largely, if not chiefly, to the decapitation of the numerous 'forces' of the science other than the one which is the product of mass and acceleration. It seems like a step backwards, therefore, to encounter in this capital work some new species of force in addition to many of the species which have long been fossil in the best English terminology. Clearness of physical principles would seem to exclude all such terms as Drehkraft, Schiebekraft, Stofskraft, etc., along with lebendige Kraft. We shall hope

that future volumes of the authors will follow English terminology more closely, since, without regard to race prejudice, it appears vastly superior to that of other languages. The lack of a generally accepted precise terminology in French and German appears to have led the authors to attribute a similar indefiniteness to English terms wherein such defect does not exist. Thus, on page 81, they say: "Gewöhnlich wird in den englischen Büchern statt Impuls das etwas farblos wort momentum benutzt; die Komponenten des Impulses heissen dan 'the moments of momentum.' (!)"

R. S. W.

An Illustrated Flora of the Northern United States, Canada and the British Possessions, from Newfoundland to the parallel of the southern boundary of Virginia, and from the Atlantic ocean westward to the 102d meridian. By NATHANIEL LORD BRITTON, PH.D., and HON. ADDISON BROWN. Vol. III., Apocynaceae to Compositae; Dogbane to Thistle. New York, Charles Scribner's Sons. 1898. Large 8vo. Pp. xiv + 588.

A little less than two years ago (August 22, 1896) the first copies of Volume I. of this important work were distributed; less than a year later (June 15, 1897) a copy of Volume II. reached the writer; now (July 5) the third and last volume is at hand. When we bear in mind that these three volumes include descriptions of 4,162 species, and that every one of these is illustrated by outline drawings, one-half to three-fourths natural size, with many additional figures somewhat enlarged, we are able to realize the great amount of labor involved in their preparation and publication. The authors and publishers are to be congratulated upon such prompt completion of this work, whose value is greatly increased by the fact that so short a time has elapsed between the appearance of its volumes.

It is not necessary here to speak of the peculiarities of these volumes, since every working botanist in this country is familiar with them. The modern nomenclature, following the famous 'Rochester Rules,' and the modern sequence of families, following the system of Engler and Prantl, distinguish this from every other systematic work on the plants of North America. It follows that those who do not like the Rochester Rules will not like this book, nor will those who persistently adhere to the Candollean sequence of families. However, it is inevitable that one result of its publication will be that the number of those actively opposing these modern features will rapidly grow less. It will soon be much easier to follow the modern innovations along the plain highway here made than to continue in the less and less frequented paths of the conservatives.

The General Key to the Orders and Families will be helpful, not only as a key, but also as affording a synoptical view of the system adopted. While necessarily keys are all much alike, this one shows in many ways the influence of the modern ideas in regard to plants. Here and there a slip occurs, and now and then there is a patch of old cloth used in the new garment. But these are to be expected, and they are not serious blemishes. In a second edition, for example, we may have a correction on page viii of the statement which makes embryo-sac synonymous with macrospore, and of the description of the leaves of Isoetacae as 'tubular.'

Having accomplished so good a work the authors now owe it to the botanical public to bring out a small, thin-paper edition, without illustrations, so that all the descriptions may be brought within the limits of a small book. If the publishers will then give it a flexible binding, with narrow page margins, they will make a most useful book, which will be a fine adjunct to the fine large three-volume edition now before us.

CHARLES E. BESSEY.
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SCIENTIFIC JOURNALS.

THE contents of the *American Journal of Science* for August are as follows: 'Jurassic Formation on the Atlantic Coast—Supplement:' By O. C. MARSH. 'Mineralogical Notes:' By C. H. WARREN. 'Origin and Significance of Spines—A Study in Evolution:' By C. E. BEECHER. 'Prehistoric Fauna of Block Island, as indicated by its Ancient Shell-Heaps:' By G. F. EATON.

'Registering Solar Radiometer and Sunshine Recorder:' By G. S. Isham. 'Tertiary Elevated Limestone Reefs of Fiji:' By A. Agassiz. 'Iodometric Determination of Molybdenum:' By F. A. Gooch and J. T. Norton, Jr. 'Sölvsbergite and Tinguaite from Essex County, Mass.:' By H. S. Washington. 'Occurrence of Native Lead with Roeblingite, Native Copper and other Minerals at Franklin Furnace, N. J.:' By W. M. Foote. 'Position of Helium, Argon and Krypton in the Scheme of Elements:' By W. Crookes.

The *American Naturalist* for July opens with the first part of an article by Mr. C. R. Eastman on the 'Dentition of Devonian Ptyctodontidæ.' Mr. Outram Bangs contributes a list of the mammals of Labrador supplementary to that prepared by Mr. A. P. Low. There are short articles on variations in the number of ray-flowers in the White Daisy by Mr. F. C. Lucas and on the development of Mantis by Mr. T. D. A. Cockerell.

SOCIETIES AND ACADEMIES.

ENGELMANN BOTANICAL CLUB.

The Club met July 14th, ten members present.

Mr. C. H. Thompson discussed the distribution, pollination and dissemination of North American *Lemnaceæ*. In opposition to the current view of wind pollination, Mr. Thompson adopts Ludwig's theory of insect pollination as most consistent with *Lemna* structure. Local dissemination is by means of currents of water and wind and by aquatic insects. Fronds are carried to greater distances by adhering to water fowls.

Dr. Joseph Grindon presented a list of plants observed by him in Forest Park with their time of flowering.

Mr. J. B. S. Norton mentioned finding *Helianthus petiolaris*, *Sesbania macrocarpa*, *Salsola Kali Tragus* and other plants introduced about East St. Louis, and *Stenanthium robustum* in Forest Park, where it was collected by Dr. Engelmann many years ago, but west of the range usually given for that species. He also spoke briefly of Darwin's recent observations on stomata.

The meeting of July 28th was devoted to informal talks on botanical topics of interest to the members present.

J. B. S. Norton,
Acting Secretary.

ACADEMY OF NATURAL SCIENCES, OF PHILADELPHIA, JULY 26, 1898.

Mr. Wilfred H. Harned, alluding to the report that clay was eaten in certain places in the Southern States, read a letter from a correspondent intimating that the practice could not be met with there.

Mr. Benjamin Smith Lyman remarked that on the Island of Yesso he had been shown a white clay which was said to be eaten by the natives.

Professor Henry A. Pilsbry exhibited a number of shells of the genus *Cerion*, illustrating the fact that each of the Bahama Islands has its own peculiar species. He had been told that in Cuba the habitats of the species of this genus are almost as well defined as are those of the islands. No one species is generally distributed over the entire island nor along any great extent of sea-board. Specimens of *Cerium incanum* from the Florida Keys were also exhibited. The speaker suggested that an examination of the Keys would probably reveal a similar definition of local forms.

A paper entitled 'A New Land Snail from Clarion Island,' by Henry A. Pilsbry, was presented for publication.

Edw. J. Nolan,
Secretary.

NEW BOOKS.

L'Année Psychologique. Alfred Binet. Paris, Schleicher Frères. 1898. Quatrième Année. Pp. 849.

Electricity and Magnetism. Francis E. Nipher. St. Louis, J. L. Boland. 1898. 2d Edition. Pp. xi + 430.

Special Report on the Beet-sugar Industry of the United States. Washington, Government Printing Office. 1898. Pp. 239.

The Birds of Indiana. Amos W. Butler. From the 22d Report of the Department of Geology and Natural Resources of Indiana. 1897. Pp. 516–1187.